Your Thesis Title

UNIVERSITY OF
LINCOLN

Jane Smith

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Submitted in partial satisfaction of the requirements for the
degree of

BSc (Hons) Computer Science

School of Computer Science

University of Lincoln

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A blank page

This is an optional page environment you could use for things like:

- Your own custom preamble chapters (use `\chapterTitle` for titles!)

- *"This work is dedicated to..."*

- A copyright notice

- Additional notes

- Quotes

- List of publications

- An actual blank page

- Nomenclature / glossaries, etc.

It is not recommended to use this in your undergraduate thesis for submission. It has been left in here to make you aware of its existence. This is largely because it does not follow the guidelines set out for undergraduate theses, but you could include this environment for your own personal printed copy. Consult with your supervisor to see if you can use it.

In addition, you can pass an optional parameter to this environment with the value `c` to centre this text vertically on the page (use the `center` environment to align horizontally).

Acknowledgements

Firstly, I want to thank somebody, and somebody else.[1] Here is another note.

---

[1]Here is a footnote

Abstract

This is where your abstract will go. Usually this is written last, after writing the entirety of your thesis.

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Chapter 1

Introduction

Thank you for using the Unofficial University of Lincoln Computer Science Undergraduate Thesis template! This template was authored by Benjamin Williams, inspired heavily from the template I made for postgraduate theses. If you are a postgraduate please check out my other thesis template on the Overleaf gallery for PGR theses. If you have any troubles, requests, or issues please get in touch with me at `bwilliams@lincoln.ac.uk`.

1.1 Cautionary Note

As hinted by the title, this template is the **unofficial** template for the UoL's SoCS. As such, it is worth consulting your supervisor on it's usage for your thesis before using it. You should definitely do some research into this – double and triple check that you are okay to use it, and it conforms with **your** assignment requirements. I am not responsible if this template does not conform to what is needed. However, it is worth noting that:

1. This template *should* provide *all* of the required formatting for your undergraduate thesis, as required by the module;

2. Provides auxillary environments for typesetting ease – such as ludography and in-built features of LaTeX, and;

3. Formats references automatically in accordance with Harvard referencing, a requirement for the UoL's SoCS undergraduate dissertations.

This is your introductory chapter. I do not include any guidance on how to write these chapters, but instead show you how to operate features of the template. The template is pre-formatted in accordance to the School of Computer Science's undergraduate thesis requirements. For example, this is double-spaced with the correct margin values and header formats.

1.2   Template Structure

Over on the left of this screen (assuming you're in Overleaf), you should see the file structure of this template. There are a few folders and files which are important. It is worth noting that this structure is the one I follow, and you are free to use whatever structure works best for you. In this template, the `chapters` folder is where all the chapters throughout the document are located. This includes other sections, such as the abstract, acknowledgements and reflective analysis.

By contrast, the `preamble` folder contains files which are used before the document is rendered. Think of this like the `head` tag in HTML: the files in this folder provide important meta-data (such as your name, student number etc) prior to the document being rendered. Your first task should be to modify this template, by opening up `preamble/details.tex` and inserting your own details. If you wish to use a package in your document, you can easily add it to the `preamble/packages.tex` file, and it will be imported. Furthermore, the `preamble/bib-setup.tex` file is used to import references and set-up BibLATEX, but that is covered later in this document.

1.3   Table of Tables (ToT) and Table of Figures (ToF)

At the beginning of this document, you probably noticed these two sections which were included before this chapter, and after the abstract. These are the table of figures and the table of tables. Lets include an image, and notice how it appears in the table of figures above as Figure 1.1.

Figure 1.1: The University of Lincoln's black-on-white crest, used in the title page of this thesis.

In addition, here is an example of a table. Whilst not strictly required, it is worth noting that Table 1.1 (on the next page) is formatted in accordance to normal usage in scientific articles. If you wish to create tables, it's probably best to use a LaTeX tables generator, like `http://tablesgenerator.com/`.

Table 1.1: A list of house plants and their details.

Name	Type	Location	Size
Billy	Peace Lily	Living room, on bookshelf	Massive!
Jezza	Calathea	Living room, on fireplace	Fairly big
Juno	Laurel Bush	Kitchen Window	Fairly big
Jade	Jade Plant	Bathroom Window	Mediumish
Bernard II	Ivy	Kitchen Window	Big
Shelley	Geranium	Bedroom Window	Small
Benth	Kalanchoe	Desktop	Big

1.4   Typesetting Math

As computer scientists, we often need to describe things with mathematical symbols or operators. Luckily, mathematical typesetting is part and parcel of LaTeX, with many solutions to this problem. This template uses the `amsmath` package for mathematical typesetting, alongside the `amssymb` package. For example, you can use in-line math formatting (with single dollars) like this:

For each $\mathbf{p} \in P$, the weight $w = (\mathbf{p}_0 \cdot \mathbf{p}_2) - \mathbf{p}_1$ was calculated. This linear operation had a time complexity of $\mathcal{O}(n)$.

Double dollars will centre your math without an equation number, like so:

$$f(x) = \int_{-\infty}^{\infty} \hat{f}(\xi)e^{2\pi i x \xi}d\xi$$

And finally the `align` environment will allow to reference and align equations, like in Equation 1.1 and 1.2 below. Notice how both = symbols are aligned horizontally.

$$a = b + 1 \tag{1.1}$$

$$\frac{\hbar^2}{2m}\nabla^2\Psi + V(\mathbf{r})\Psi = -i\hbar\frac{\partial\Psi}{\partial t} \tag{1.2}$$

But what if you want to align two or more equations but have no equation numbers? Well, thats a job for the `align*` environment:

$$\begin{aligned}
d(\mathbf{a}, \mathbf{b}) &= \sqrt{(a_0 - b_0)^2 + (a_1 - b_1)^2 + ... + (a_n - b_n)^2} \\
&= \sqrt{\sum_{i=0} n(a_i - b_i)^2} \\
&= ||\mathbf{a} - \mathbf{b}|| \\
&= \sqrt{(\mathbf{a} - \mathbf{b}) \cdot (\mathbf{a} - \mathbf{b})}
\end{aligned}$$

1.5   Hmm, the margins seem big? Especially on the left of the page?

Yeah, that's okay. This is done by design as your thesis will be printed and bound on one side, so you need extra room on the left so the text doesn't fall into the bind on your page.

The margins used in this template are the standards for postgraduate research theses, which are also applicable for undergraduate theses too. The reason for the large

margins and big spacing is so those marking your work can write in notes and red-pen your thesis easily. So yeah, don't worry about it!

Chapter 2

Literature review

Another cool thing about LaTeX is its referencing system. This template is set up to use harvard-style referencing. You can do this by using `\citep{citekey}`. It will print out something like this: (Aad et al., 2012). Or alternatively, you can use `\cite{citekey}` to cite things like this: Chatrchyan et al., 2012. This template uses BibLaTeX for referencing, with a Biber backend. This is primarily due to the extensive features BibLaTeX provides, along with the option of glossaries. If you want to customise the referencing style, you can either modify the template slightly to use different options, or use `\usepackage` again to reimport it. There's probably some commands to change its options after its been imported too.

2.1 Ludography

This thesis template also contains an optional ludography. This is primarily for Games Development students, who wish to cite games in their thesis. To use this, just put references into your bib file as usual with the game's details. Then, make sure `keywords` is set to `{game}`. This is what is used to determine which references are games, and which are actual papers. For a more elaborate example, see `bib/ludography.bib`.

Also, make sure that the `title` key is actually the author of the game, and the `author` is the title of the game. The reason this is swapped around is because BibLaTeX likes to print references out with the author first. Then, just add `\printLudography`

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with an optional title argument to print out all citations like `\printLudography` or `\printLudography[Games]`.

You can also use the `ludography` environment if you wish to print out some text before the list of games is printed. An example of this can be seen in `main.tex`. To cite games, you can `\cite` it like any other reference. However, if you want it to display the title instead of the standard referencing style, you can use `\citeGame` instead.

Here is an example of a cited game with a normal reference style: Space Invaders, 1978. Ugh, pretty ugly. Instead, here the two are cited in the next sentence as games with `\citeGame`. Both *Space Invaders* and *Breakout* were games made by Atari. Much better!

Chapter 3

Methodology

Chapter 4

Implementation

Chapter 5

Conclusions

Chapter 6

Reflective Analysis

References

Aad, Georges et al. (2012). 'Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC'. In: *Physics Letters B* 716.1, pp. 1–29 (cit. on p. 6).

Chatrchyan, Serguei et al. (2012). 'Observation of a new boson at a mass of 125 GeV with the CMS experiment at the LHC'. In: *Physics Letters B* 716.1, pp. 30–61 (cit. on p. 6).

Ludography

Breakout (1976). *Atari* (cit. on p. 7).

Space Invaders (1978). *Atari* (cit. on p. 7).

Appendix A
Some random python code

This template includes the `minted` package, which allows you to import code and syntax highlight it. For example, the text below is imported directly from the `code/test.py` file using the `\inputminted` command:

```python
str = "The times table";
print(str);
print(len(str) * "=");

for i in range(1, 13):
  for j in range(1, 13):
    print("%2d x %2d = %3d" % (i, j, i * j));
  print("-" * 13);
```

And here is a snippet of Python with the `minted` environment:

```python
# Why don't you try running this?
# See what it does? hm?

m = [ 2, 3, 0, 1, 4 ];
x = [ 'rmdq', 'd', 'n`slk', 'odftp`v)', 'hdk' ];

c = ''.join(list(map(lambda y: chr(ord(y) ^ 5).upper() + ' ' if y
 ↪  != ' ' else '  ', ' '.join([ x[m[i]] for i, v in enumerate(x)
 ↪  ]))));

print('%s\r\n%s\r\n%s\r\n' % ('=' * len(c), c, '=' * len(c)));
```

Minted supports many, many languages – so you're not just limited to Python. For example, here's some random C++ code.

```cpp
void CTimesTable::Print(const int number, const int upTo) const
{
    for(int i = 1; i <= upTo; i++)
        printf("%d x %d = %d\r\n", number, i, number * i);
}
```

Appendix B
Some other stuff

Here is just an example of some other stuff.